9Adv

Chapter (4)

Chapter 4: forces in 1 dimension

PHYSICS

Prepared by: Mr.Yazan Odetalla

Mobile: 0543347424

Carve your name on the moon!

- Physics: a branch(فرع) of Science that involves the study of physical world (energy, matter and how are they related.
- Scientific methods: steps to explain physical problems.

Steps:

1. state the problem
2. gather information
3. form a hypothesis
4. test the hypothesis
5. analyze data
6. draw conclusions

- Hypothesis: a possible explanation for a problem using what you know and what you have observed using the scientific method.
- Model: a representation of an idea, structure or object that helps people to understand it (some times need improvement from time to time example: the atom model page 7)

***What is the difference between the scientific theory and the scientific law?

- Scientific theory : explains things based on observations and investigations, when the results always support the hypothesis we call it a theory
  - theories explain **why & how** things happen.
  - theories may change if new information is available.
- Scientific law: describes **what** will happen for things in nature (usually with a Mathematical relationship)
  - laws are true all the time
  - example :law of gravity :things will fall to the ground (this is what will happen)
  - to understand why things fall we need theories
- SI units: the results would be understood by everyone in the world if we use units that are agreed on(متفق عليها) by all the world.
    - Base units(الوحدات الأساسية) :
      - Length (m) meter
      - mass (kg) kilogram,
      - time (s) second
      - temperature (K) Kelvin
      - amount of substance (كمية المادة) (mol) mole
      - electric current (التيار) (A) Ampere
      - luminous intensity (شدة الإضاءة) (cd) candela

- Derived units (الوحدات المشتقة) :Made from the base units

Example $speed = \frac{distance(m)}{time(s)}$ $speed\ (\frac{m}{s})$

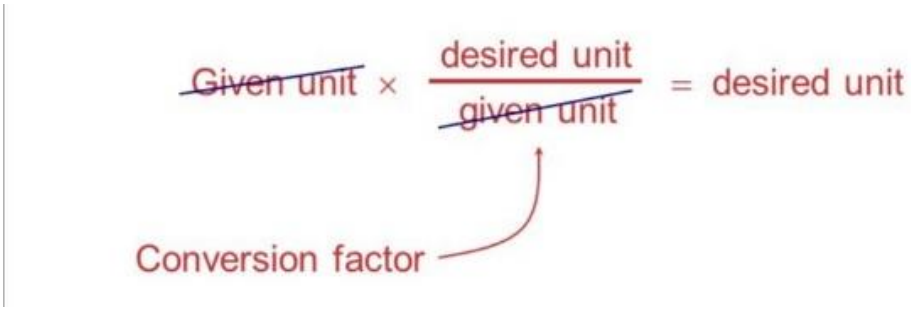
- Prefixes: used to simplify very big or very small numbers

MEMORIZE
حفظ غيبًا

Table 2 Prefixes Used with SI Units

Prefix	Symbol	Multiplier	Scientific Notation	Example
femto–	f	0.000000000000001	10^{-15}	femtosecond (fs)
pico–	p	0.000000000001	10^{-12}	picometer (pm)
nano–	n	0.000000001	10^{-9}	nanometer (nm)
micro–	μ	0.000001	10^{-6}	microgram (μg)
milli–	m	0.001	10^{-3}	milliamps (mA)
centi–	c	0.01	10^{-2}	centimeter (cm)
deci–	d	0.1	10^{-1}	deciliter (dL)
kilo–	k	1000	10^{3}	kilometer (km)
mega–	M	1,000,000	10^{6}	megagram (Mg)
giga–	G	1,000,000,000	10^{9}	gigameter (Gm)
tera–	T	1,000,000,000,000	10^{12}	terahertz (THz)

- Dimensional analysis: method used to convert units using a conversion factor(معامل تحويل)
  - Conversion factor always equal 1



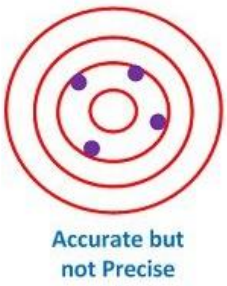
  - Given unit (الوحدة المعطية بالسؤال)
  - Desired unit: (الوحدة المطلوب التحويل اليها)
  - Example: see page12

Significant figures:

- All numbers from 1 to 9 are significant
- Zeros:
  - Zeros to the left are not significant 0.0021 has only 2 significant figures(2&1)
  - Zeros in the middle are always significant 1024.607 has 7 significant figures
  - Zeros to the right with the decimal point (الفاصلة العشرية) are significant 150.0 has 4 significant figures (1,5,0 and 0 because there is a decimal point)
  - Zeros to the right without the decimal point maybe significant or maybe not significant 1500 could have 2 significant figures or 3 significant figures or 4 significant figures
  - How do we know? only if the question say
  - Better way to write these numbers is the scientefic notation
    - $1500 = 1.5 * 10^3$ two significant figures(because now we have a decimal point)
    - $1500 = 1.50 * 10^3$three significant figures
    - $1500 = 1.500 * 10^3$four significant figures

- Addition and subtraction with significant figures:
  - We only look at the number of figures after the **decimal point** the answer must have number of digits after the decimal as in the **least** one of the original numbers
  - Example: 3.21 + 173.1 = 176.31=176.3
    2 (1) 1

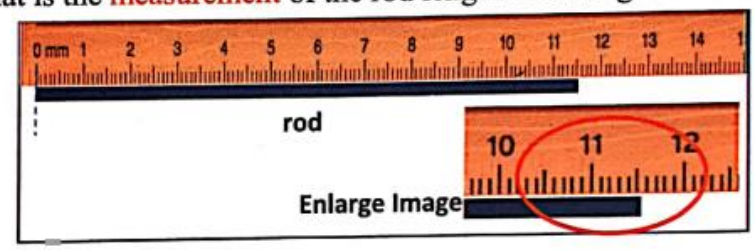
- Multiplication and division with significant figures:
  - We look at the total number of significant figures the answer must have significant figures as in the **least** one of the original numbers
  - Example: 3.21 * 173.1 = 555.651 = 556
    (3) 4 3
- measurement: is a comparison between an unknown quantity and the standard known quantity
- Precision versus accuracy :
  - Precision :represents how close(مدى قرب) the measurements are to each other (لبعضها البعض)
  - Precision =1/2 of the **smallest division** of an instrument
  - Accuracy: represents how close the measurement is to the true value
  - For example measurement of 111.1 g is accurate to the nearest tenth of gram, 111 is accurate to the nearest 1 gram and 111.13 is accurate to the nearest hundredth.



Prepared by: Teacher. Yazan Odetalla

· Depending on the figure, what is the measurement of the rod length including the uncertainty?

- ❒ $(11.55 \mp 1.0)\ mm$
- ❒ $(11.55 \mp 0.5)\ mm$
- ❒ $(115.5 \mp 0.5)\ mm$
- ❒ $(115.5 \mp 1.0)\ mm$



- the reading is 11.55 cm, convert to mm because all options are in mm it will become 115.5 mm
- Precision =1/2 of the **smallest division** of an instrument = ½ * 1mm = 0.5 mm
- So the answer is C **115.5 ±0.5 mm**

- Parallax is when we look at the measuring device from the wrong position or angle (page:16)
- Independent variable is the variable that we change during experiments or it doesn't depends on anything else. Example: time (x-axis)
- Dependent variable is the variable that changes automatically when we change the independent variable (y-axis)
  - Independent variable is always on the x axis
  - Dependent variable is always on the y axis

- Linear relationship is a graph of straight line that can be represented by Y = mx + b
  - B is the Y Intercept it is the point where the line crosses the y axis
  - M Is the slope which is equal to the Rise/ run or $m = (\Delta Y)/(\Delta X)$
  - After we find the relation for y we can use it to find values that we didn't knew before by substituting the value of x into the equation.
- Nonlinear relationships

There are many types of nonlinear relationships we will mention only two of them

1. Quadratic relationship: one variable depends on the square of another

$$y = ax^2 + bx + c$$

The values of a b and c can be found using a computer or a graphing calculator

2. inverse relationships: the value of one variable increases the value of the Other variable will decrease

$$y \uparrow = \frac{a}{x \downarrow}$$

The value of a is found by choosing any point at the graph and substituting the x and y values in the equation above

- The graphs of these relationships are shown in pages:21 & 22

- Example: spring with mass (when the mass increases the spring will be longer)

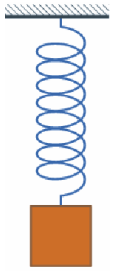
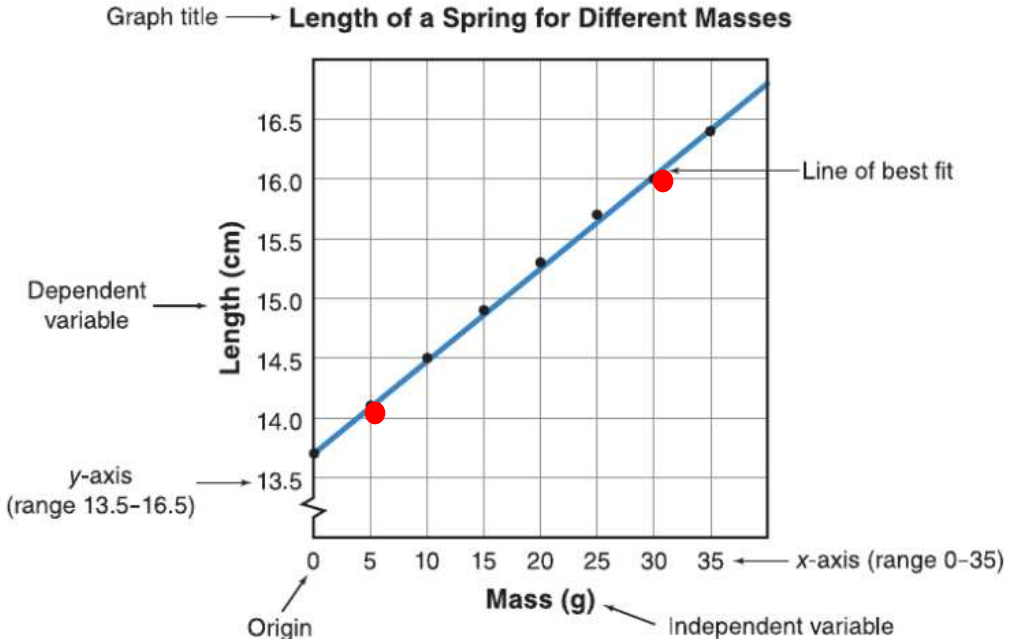


Table 3 Length of a Spring for Different Masses

Mass Attached to Spring (g)	Length of Spring (cm)
0	13.7
5	14.1
10	14.5
15	14.9
20	15.3
25	15.7
30	16.0
35	16.4



- From the graph we can see that the relationship is linear.
- The y-intercept (b=13.7)
- The slope $m = \frac{16cm-14.1cm}{30g-5g} = 0.08\ cm/g$
- So $y = 0.08x + 13.7$ ||| y is the length and x is the mass
- What will the spring length be with a mass of 23g
    - From the graph above 23 g on the x-axis corresponds with 15.5 cm length
- What will the spring length be with a mass of 49 g
    - 49g is not shown in the graph so we use the equation
    - $y = 0.08(49) + 13.7 = 18cm$

Equations and formulas summary

$speed = \frac{distance}{time}$	Precision=1/2 smallest division